



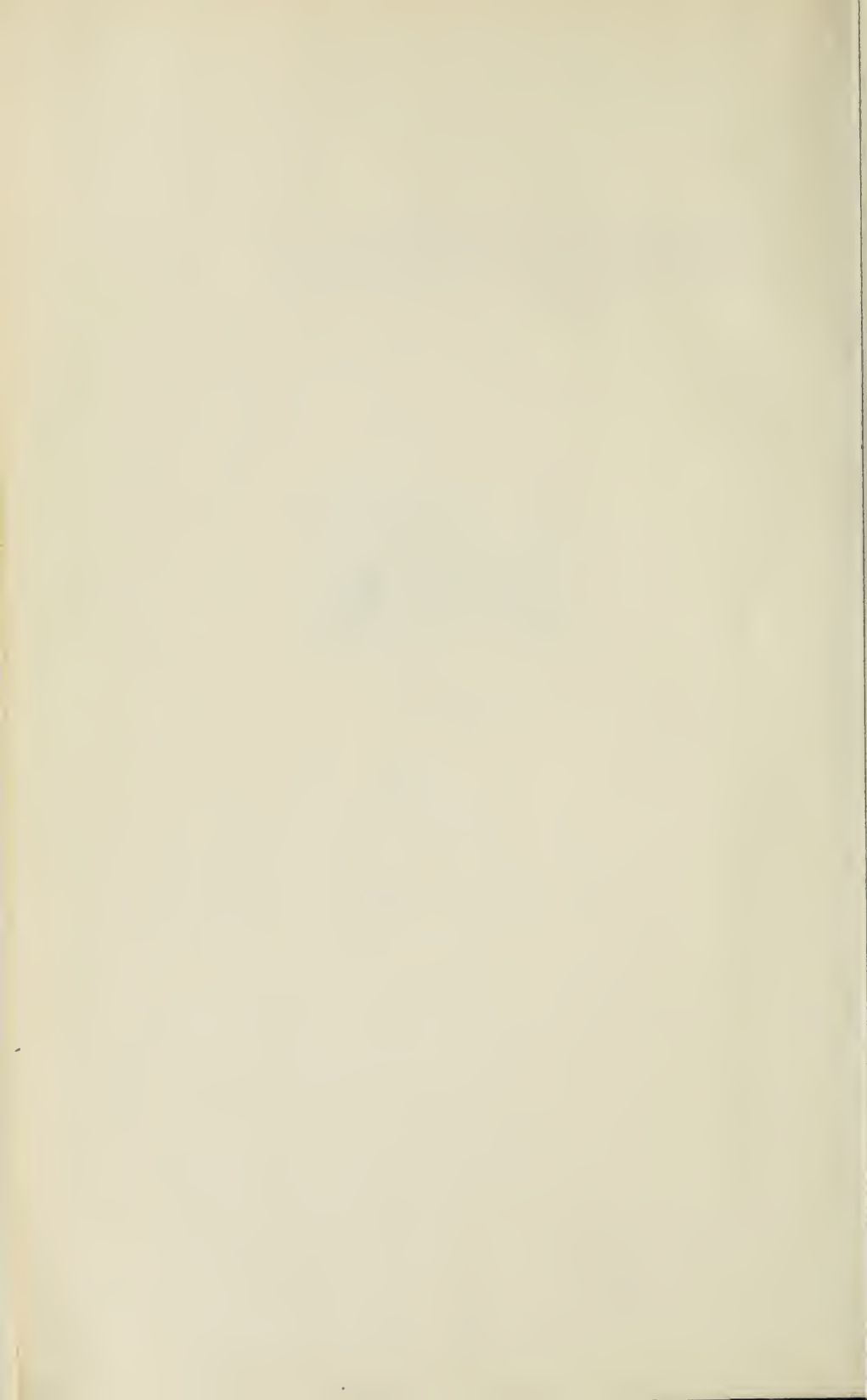
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JOB *Evaluation*



Institute of Labor and Industrial Relations

UNIVERSITY OF ILLINOIS

BULLETIN

Editorial Note

This University of Illinois *Bulletin* is one of three to be published by the Institute of Labor and Industrial Relations on Industrial Engineering topics. The topics are *Job Evaluation*, *Motion and Time Study*, and *Wage Incentives*. These *Bulletins* are not intended to "promote" the use of these techniques, but to aid managements and unions which have decided to adopt them.

The Institute of Labor and Industrial Relations was established at the University of Illinois in 1946 to "inquire faithfully, honestly, and impartially into labor-management problems of all types, and secure the facts which will lay the foundation for future progress in the whole field of labor relations."

The *Bulletin* series is designed to carry out these aims by presenting information and ideas on subjects of interest to persons active in the field of labor-management relations. These *Bulletins* are nontechnical, for general and popular use.

Additional copies of this *Bulletin* and others listed on the inside back cover are available for distribution.

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JOB EVALUATION

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INTRODUCTION

"Ten cents an hour more than me. And he's just a janitor. Here I am a laborer, getting the heavy work all day, while he just pushes a broom. I want a raise!"

An age-old argument, and an age-old puzzle. Which jobs are the most important? Which are worth more pay? And, how much more?

The puzzle gets tougher if wage rates are assigned haphazardly, assigned without regard to job contents and to other jobs.

One method designed to help solve this puzzle is job evaluation. Job evaluation is a systematic procedure to help determine, through a study of job content, the relative worth and pay of jobs and positions within a plant.

Many other factors — social, economic, and psychological — are also involved in labor-management relations and must be considered. But these other factors are beyond the scope of this *Bulletin*. Only job evaluation techniques will be considered here, for this *Bulletin* is not directed to the expert. Rather it is aimed at the person in the labor-management relations field who is not directly dealing with industrial engineering, but who wants to know some of the methods and procedures in use.

JOB EVALUATION

Job evaluation has brought some order out of the haphazard assigning of prevailing wage rates. However, it is still not foolproof. Much still needs to be done in the over-all understanding of the economic and social aspects of job evaluation; more must be learned about the sociological and psychological influences on workers; more must be learned about men's reactions to changes in traditional money rates.

As yet, there is only one real criterion for a good job evaluation plan: continued acceptance by both management and labor.

Although job evaluation shows the relative worth of jobs, it is only one of several elements which determine how much money the worker will be paid. Some other elements also influencing this relative total wage rate include the general economic conditions of the country or the industry, the competitive advantage of the plant, cost of living, relation of wage costs to other cost items, and individual or collective bargaining.

Job evaluation does not replace individual or collective bargaining. Instead, it makes — or can make — the bargaining process more systematic and orderly. It does this by establishing a uniform measuring scale for all jobs. This measuring scale may provide single rates or rate ranges for the various ultimate labor grades used.

In the determination of total hourly rates, job evaluation is concerned

CHART I

Name of Job	Labor Grade	Wage Rate
Janitor	1	.95-1.05
Lathe operator	4	1.25-1.45
Toolmaker	6	1.40-1.60
<p>Note: Illustrative only, many more cases would be present in any one plant.</p> <p>These money rates do not necessarily reflect the present economic conditions.</p>		

only with measuring one job in relation to other jobs and thus establishing the relative base rates. Other industrial relations and management engineering techniques, such as motion study, time study, and the use of wage incentive plans, may be, but are not necessarily, used with job evaluation.

If the parties do decide to use one or more of these techniques with job evaluation, they should be sure that the techniques are interrelated. To clearly understand the part that job evaluation plays in influencing the total wage rate, look at the cases of Phil and Harry:

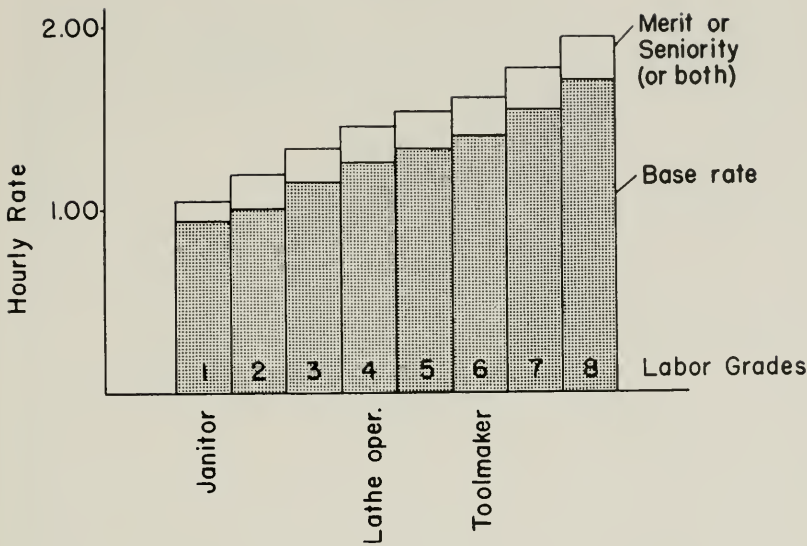
Phil works eight hours a day, 40 hours a week. He gets paid a straight hourly rate, regardless of how much production he turns out. He's been doing the job for a long time. His job is not on incentive.

Of course, Phil has to do a certain amount of work to keep his job. But, there is no time standard set for the work. Phil's foreman has an idea about a reasonable day's work. Phil does it. And, because of his seniority and merit, Phil makes a little more money per hour than some of the other fellows doing similar work.

Phil's pay check can be worked out by a formula:

Total earnings = (actual hours on the job) \times (basic hourly money rate for the job + extra money per hour because of specific person doing the work).

FIGURE I



To get a picture of this on a plant-wide scale — a comparison of non-incentive jobs of similar and dissimilar nature—see Chart I and Figure I.

Harry works in another part of the plant. He works on an incentive — a bonus, or piecework — job. Harry has a certain amount of work he has to turn out every day, a quota. He gets paid an hourly rate, just like Phil, for being on the job eight hours — for meeting the quota. This quota may be expressed in many ways, such as: (1) minutes per piece, (2) hours per piece, (3) pieces per hour, or (4) money per piece.

Harry has been doing his job a long time. Thus, like Phil, he has a higher base rate per hour than some of the other fellows doing similar work. But, unlike Phil, he can earn extra money by producing more than his quota.

Harry's pay check can also be worked out by a formula. The first part of the formula will be just like Phil's:

$$\text{Total guaranteed earnings} = (\text{Actual hours on the job}) \times (\text{basic hourly money rate for the job} + \text{extra money per hour because of the specific person doing the work}).$$

But — in finding Harry's total earnings — to this is added the incentive earnings. Thus the formula becomes:

CHART II

Name of Job	Labor Grade	Base Pay	Incentive Pay (average)	Total Pay
Janitor	1	.95-1.05	Non-incentive	.95-1.05
Lathe operator	4	1.25-1.45	.31	1.56-1.81
Toolmaker	6	1.40-1.60	.35	1.75-2.00

Note: Illustrative only, many more cases would be present in any one plant.

These money rates do not necessarily reflect the present economic conditions.

Total earnings = (total guaranteed earnings) + (time allowed — time actually taken on the job) \times (basic hourly money rate for the job + extra money per hour because of the specific person doing the work) \times (some percentage).

Comparison of the earnings of a person on an incentive job with those of persons on similar or dissimilar incentive jobs is shown in Chart II and Figure II.

A comparison of Figure I and Figure II shows that there has been a "stacking" of a money rate upon a money rate. In each case — Phil's and Harry's — the base rate for the job influences the total earnings very much.

In everyday practice, the stacking method is determined by the relative soundness of a particular organization's program of job evaluation, motion study, time study, and the use of a wage incentive plan and, where there is an established union, by the processes of collective bargaining. However, the whole relationship between incentives, job evaluation and production standards should be explored. This is especially so as the total rate tends to destroy, among other things, the historic differentials between jobs, and this destruction can have a profound effect on the results.

Chart III and Figure III show the relative area covered by job evaluation in determining the total hourly rate. (This particular illustration

FIGURE II

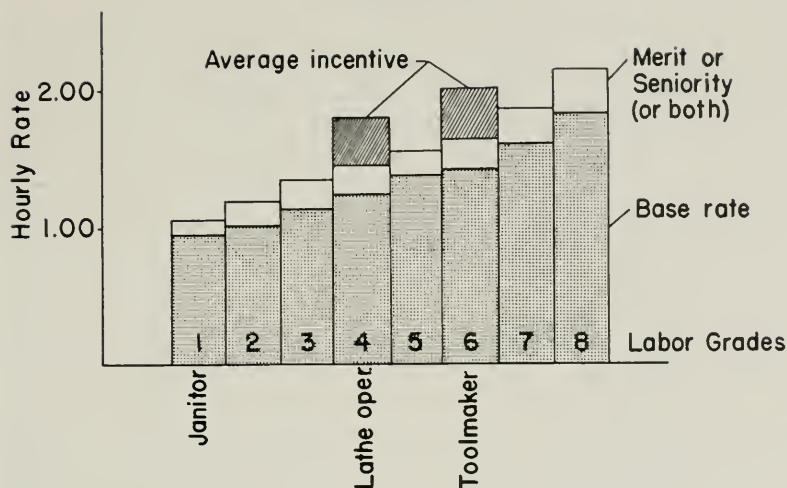
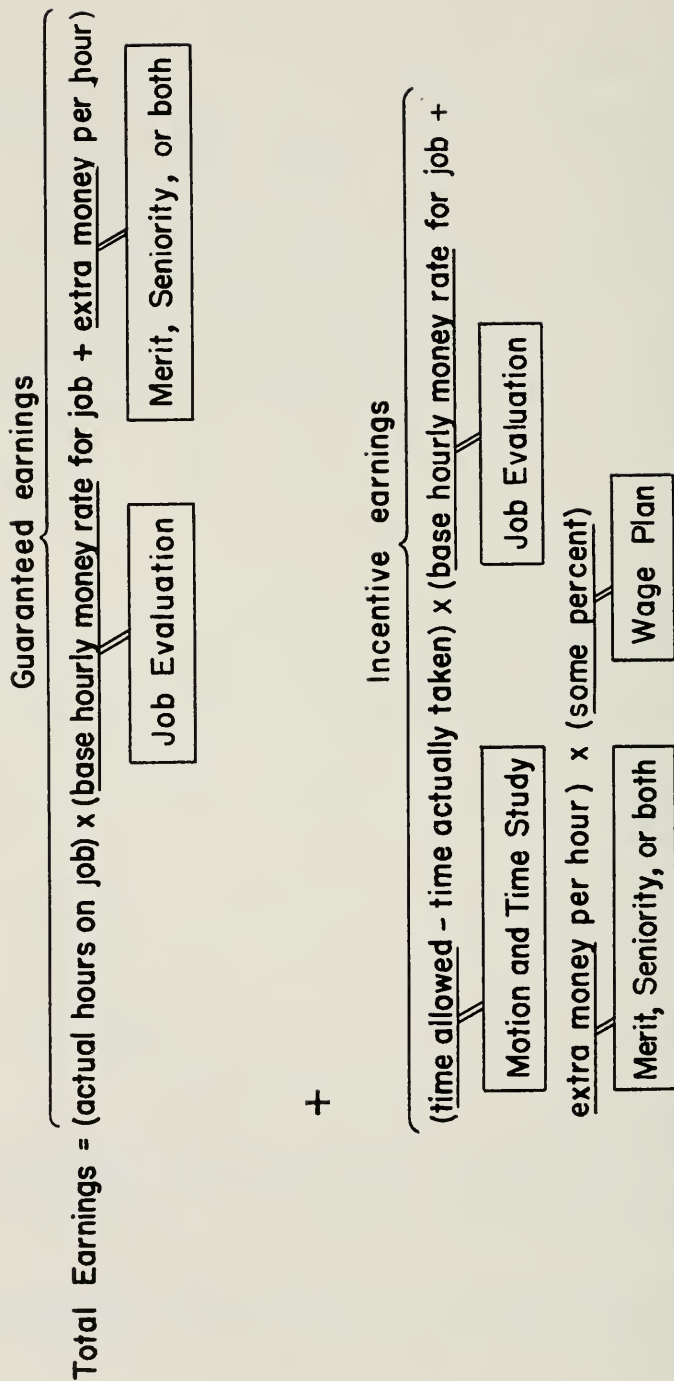


CHART III

Name of Job	Labor Grade	Base Pay	Incentive Pay (average)	Total Pay
Janitor	1	.95-1.05	Non-incentive	.95-1.05
Lathe operator	4	1.25-1.45	.31-.35	1.56-1.81
Toolmaker	6	1.40-1.60	.35-.40	1.75-2.00

FIGURE III



JOB EVALUATION HISTORY

Job evaluation is not new. As early as 1871 the United States Civil Service Commission adopted a rough form of evaluation which consisted largely of merely classifying jobs. A more modern type of job analysis was started in 1909 in Chicago for the Civil Service Commission and the Commonwealth Edison Company.

But, it was not until about 1924 that a comprehensive, present-day type, evaluation system was first tried. Merrill R. Lott, a director of personnel in several companies, developed it. Since his work, there have been great fluctuations in types — but few basic changes. Perhaps the greatest increase in the development and use of job evaluation plans has been since 1940 — especially during and since the wage stabilization period of World War II.

There has been a very uneven adoption of job evaluation programs. Even within any one industry, a uniform acceptance cannot be seen, except perhaps in the most recent attempt in the basic steel industry.

Much of this uneven development is explained by lack of interest on the part of management and by the opposition of unions in some plants and industries. The lack of management interest usually is the result of a feeling that the existing wage rate structure is adequate or that the cost of installing a job evaluation program (in terms of both money and worker adjustments) would not be justified by the results. Union opposition has been based on several different grounds. Some union representatives have a long-standing fear that job evaluation would lead to wage rate cutting. Others have reacted against the more extreme claims of job evaluation enthusiasts that job evaluation automatically eliminates wage inequities and the need for bargaining over individual wage rates. Still others believe that wage structures must be flexible and adaptable to human relations considerations and that the bargaining approach is much more realistic than a set of mathematical formulas. A more detailed discussion of the reasons for various management and union points of view may be found in some of the references listed in the selected bibliography at the end of this *Bulletin*.

A considerable change in these attitudes held by some union and management people has been evident in recent years. Much of this change can be attributed to governmental wage stabilization policies during the war period. Whether the trend will continue in normal times is a speculative question.

BASIC METHODS IN USE

Lott used fifteen “factors” in his evaluation of a job. Today, some persons favor as few as three factors. Others use as many as forty.

To date, little basic research has been done to determine how many or which factors should be used. Instead, most plans now in use have been adopted completely or with minor changes from plans successfully tried elsewhere.

There are four basic methods of job evaluation now in use. These are of two types — non-quantitative and quantitative. They are:

Non-quantitative

- a. Ranking method
- b. Classification method

Quantitative

- a. Factor Comparison method
- b. Point system

Each succeeding method has more “refinements” than the preceding one. The use of these additional refinements does not necessarily make the method more nearly accurate. In fact, a limited amount of research has shown that additional refinements may actually weaken the results.

The Ranking Method

This, the simplest method of job evaluation, usually involves either of two processes:

(1) Ranking by job title only. The title of each job is placed on a card of convenient size. The cards are then stacked according to the relative importance of the jobs — accepted by common agreement. The card naming the most important job is on top, the least important on the bottom, the rest properly arranged between. A money rate, based on whatever data may be available, is then assigned to each job according to the relative position of its job-title card in the stack.

(2) Ranking by job title and job content. Here, the job content is used to assist in judging the relative importance of the jobs. Otherwise, the method is the same as that described above.

The ranking method has the advantage of simplicity, the disadvantage of lacking substantiating data for use later in justifying the relative position given certain jobs. Furthermore, if only job titles are used some aspects of the jobs may be overlooked.

The Classification Method

The classification method is used widely in many offices, especially in Civil Service. It is relatively simple. It involves only matching a specific job with a list of tasks in a predetermined labor grade. Each grade has a set money rate. The method works like this:

- (1) Establish labor grades — as many as desired.

- (2) Describe the types of functions included in each grade.
- (3) Assign money rates to each grade.
- (4) Describe each specific job.
- (5) Match work description with most closely corresponding labor-grade work type description.

Once this has been done, the labor grade is known, and so is the money rate for the work.

There are two main faults in this system. Assigning of money rates is greatly influenced by the present rate; thus inequities in pay are often continued. The second fault is in interpretation of the wording used in the job and work type descriptions. They are easily misinterpreted. This is found especially when a firm is trying to attract personnel. In such a case, the work might be matched with an unusually high labor grade and corresponding high money rate. The main advantage of the system is simplicity.

The Factor Comparison Method

This method is based on the assumption that all jobs contain certain common factors. These factors may differ in the degree to which they are present in different jobs. The factors usually are (1) skill, (2) mental demands, (3) physical demands, (4) responsibility, and (5) working conditions.

This method of job evaluation actually involves two rankings: ranking jobs by factors without regard to money, and ranking jobs by assigning to each factor a part of the total money rate. The two are compared and any differences are discussed and eliminated.

First step in the system is to clearly describe each factor in each job being evaluated. Key jobs are then selected. A key job is one which management and union agree is properly paid. It is one considered fairly common in the area and which has a money rate also common and uniform in the area. Enough key jobs are selected to cover the entire range of jobs included in the plan—from nearly the lowest to the highest types of work, with several other jobs scattered between.

The key jobs are then ranked—without regard to money—first for one factor, then for the next factor, and so on. All jobs can then be compared for each factor at a time.

Then the second ranking is done. The total money rate for each key job is broken down, a “proper” portion being assigned to each factor. These portions of money assignments will also rank the jobs in respect to one another for each factor. Differences in the two rankings are then worked out.

Now a basic scale of key jobs has been formed against which all other jobs, without consideration of their present money rate, can be ranked, factor by factor. New money rates can now be determined by using as a guide the partial money rates assigned each job in each factor.

This method is basically the same as the ranking method already described. The main difference is that each factor of each job is ranked twice, instead of each job being ranked as a whole.

The method has the same inherent weakness as the ranking method — lack of substantiating data. Furthermore, economic changes may not have the same effect on all aspects of all factors of a job; hence the whole procedure should be repeated with each economic change. Most difficult is the problem of securing sound key jobs.

In some cases, to avoid the need for re-evaluation as the economic situation changes, the second ranking by partial money rates is omitted, or is done in terms of points.

The main advantage of this method is the absence of predetermined limits such as are usually set in the classification and point system methods.

The Point System

Basically there are two types of point systems: (1) the straight point system and (2) the weighted point system.

Like the factor comparison system, the point system operates on the assumption that there are factors common to all jobs. In this system a certain number of points are assigned each job on the basis of these factors. To date, the number of factors used varies from three to as many as forty. The most popular number of factors is between ten and fifteen.

In each case the factor should be clearly and adequately described. Then, since each factor will not be of the same importance in every job, each factor is broken down into degrees. Each degree is then described clearly and adequately. The number of degrees used is somewhat a matter of choice; usually it is between five and eight.

For example, a factor such as education might be assigned 150 points. This factor might be divided into five degrees, ranging from ten points for the first degree to fifty points for the fifth degree. Selecting degrees and their points will be described in a subsequent section on page 21.

After this preliminary work is completed, each job is described and evaluated. There are two procedures of evaluation: (1) evaluate all the factors in one job, then all the factors in a second job, etc., or (2) take one factor through all the jobs, then a second factor, etc. The second method of evaluating all jobs a factor at a time is preferred.

The points assigned, the factors are added, and the sum determines the status of one job in comparison with the others. After all jobs have

CHART IV

Factor	Degrees				
	1	2	3	4	5
1. Education	10	20	30	40	50
2. Experience	10	20	30	40	50
3. Physical demand	10	20	30	40	50
4. Responsibility for process	10	20	30	40	50
5. Responsibility for safety	10	20	30	40	50
6. Responsibility for materials	10	20	30	40	50
7. Working conditions	10	20	30	40	50
8. Hazards	10	20	30	40	50

CHART V

Factor	Degrees					
	1	2	3	4	5	6
1. Education	10	20	30	40	—	—
2. Experience	10	20	30	40	50	60
3. Physical demand	10	20	30	40	50	—
4. Responsibility for process	10	20	30	40	50	—
5. Responsibility for safety	10	20	30	40	—	—
6. Responsibility for materials	10	20	30	40	—	—
7. Working conditions	10	20	30	40	50	—
8. Hazards	10	20	30	40	50	—

been evaluated, money rates are assigned following the pattern set by the points for each job.

CHART VI

Factor	Degrees				
	1	2	3	4	5
1. Education	10	20	40	80	160
2. Experience	10	20	40	80	160
3. Physical demand	10	20	40	80	160
4. Responsibility for process	10	20	40	80	160
5. Responsibility for safety	10	20	40	80	160
6. Responsibility for materials	10	20	40	80	160
7. Working conditions	10	20	40	80	160
8. Hazards	10	20	40	80	160

The straight point system and the weighted point system differ in the way points are assigned.

In the true straight point system each factor has the same number of degrees and corresponding points as every other factor, as shown in Chart IV. Chart V is a modified straight point system. It approaches the weighted point system, since the same number of degrees is not used for each factor.

In both Charts IV and V the amount of change in the points is the same from one degree to the next — here, ten points per degree. When this is the case, the scale is known as arithmetic. Should the amount of change vary from one degree to the next, the scale is known as a form of geometric scale, as shown in Chart VI.

An arithmetic scale and a geometric scale have never been used together in the same evaluation plan. One of the two scales is used for all the factors in a plan. There is, however, no evidence which proves that the scales cannot be used together. In fact, the factor comparison plan would suggest that the arithmetic scale could be used for some factors while the geometric scale could be used for other factors in the same job evaluation plan.

The weighted point system is essentially the same as the straight point system except that the factors are not all considered equally im-

CHART VII

Factor	Degrees				
	1	2	3	4	5
1. Education	10	20	30	40	50
2. Experience	30	60	90	120	150
3. Physical demand	20	40	60	80	100
4. Responsibility for process	10	20	30	40	50
5. Responsibility for safety	5	10	15	20	25
6. Responsibility for materials	5	10	15	20	25
7. Working conditions	10	20	30	40	50
8. Hazards	5	10	15	20	25

portant. This is reflected by assigning more points to some factors than others. The amount of relative importance of the factors is a matter of judgment. An example of a weighted point system is shown in Chart VII. A geometric scale could be used just as well.

The advantage of the point system is that, at a later time, data are available to show how a job was evaluated. The main disadvantage is the lack of flexibility, due to the use of a predetermined number of degrees and points which does not allow for the impact of the general economic changes.

There are several modifications and combinations, too numerous to list, of the basic plans described. With this system, as with all other job evaluation programs, the only criterion to distinguish good plans from poor ones is continued acceptance by management and labor.

ESSENTIALS OF A JOB EVALUATION SYSTEM

In any job evaluation program there are two basic problems: (1) installing some system of job evaluation and (2) maintaining the system.

In each case there are certain essentials which must be thought out and a policy established. The following sections of this *Bulletin* will point out some of the problems of installing a system. The last section, starting on page 36, will consider points about maintaining a particular system.

Establishing Policies

The first question to be answered is: "Do we want a job evaluation system?"

Two main things to be considered are (1) how good is the present method of determining relative base money rates, and (2) how well is it accepted by management and labor.

Some systems now in use may appear to be very illogical. But, if the parties involved like it, there is little reason to change. How simple or how complex the present system is should not matter in this decision.

A new plan should be considered when either management or labor is dissatisfied with the present one, or when they think that the present plan could be improved.

Any policy aimed at establishing a new plan might appropriately include statements covering:

(1) The company's position in the new system, particularly top-management support.

(2) Labor's position — varying anywhere from full partnership in all phases to acceptance of the general plan, but with the right of grievance on any particular job evaluation.

(3) The employee's stake. Usually this is covered by a guarantee that the present encumbered base money rate of any particular person will not be reduced as long as he remains on the specific job.

(4) Procedure for maintaining the system. This will include, among other things, a statement of what constitutes a change in any particular situation sufficient to cause a new evaluation of a job.

(5) The relationship between the job evaluation and the collective bargaining process and agreement.

Experience indicates that this policy statement should be worked out before the actual process of altering or establishing a system is started in detail.

Selecting the Plan

The next step is the selection of a plan. A company may adopt another company's plan in its entirety, design a tailor-made plan after a study of several systems, or develop a combination of these. The union may have a voice in the selection.

In any case the company's own staff can be used, or outside services or consultants can be secured. If outside services are used, it is essential that provision be made for training a person on the staff of the company to be responsible for the maintenance of the system after it has been installed. This training is important for two reasons. First, because of the

economic point of view — the cost of setting up the system; and second, because it serves as a means of assuring the continuance of employee or union acceptance.

The factor comparison methods and various forms of point systems are the most popular. But, in selecting one of these plans, it should be recognized that there is no absolute way to insure that the factors which are used are the only essential factors. Nor is there any way of testing to decide absolutely whether or not all the factors which are used are essential. Some guidance in selecting factors can be gained by testing the particular contribution of a specific factor and its influence on the results. This is strictly on a statistical or mathematical basis. This still leaves out certain psychological aspects, not influencing the numerical results one way or another to any marked degree, and these aspects may gain or lose the acceptance of the whole idea. The statistical aspects will be considered in a subsequent section, starting on page 36. The psychological aspects have to be left to judgment of the situation which may exist in each case.

Choosing the Factors

Guidance in selecting factors to be used in the ultimate plan can also be gained from a study of the scope of the jobs to be evaluated.

Traditionally, jobs are grouped into families, or occupational ranges. But, more fundamental categories are these:

- (1) Factory jobs, including direct and indirect labor in the factory.
- (2) Clerical positions in the numerous offices through the company.
- (3) Supervisory positions in the first lines of management.
- (4) Managerial positions in middle and top management.
- (5) Technical jobs in the staff areas of a company.

The consensus, again based almost entirely on tradition, is that no single plan can cover all these classifications; hence the use of the terms "job evaluation" for the factory and "position evaluation" for the office. Using such categories reduces the inequities which may exist within the two broad groups, factory and office. But it leaves the main inequity — that between office and factory.

This disadvantage is particularly evident in plants that have an evaluation system for the factory and none for the office, yet in which any broad shift of the wage curve for the factory group is accompanied by at least a partial shift of the wage curve for the office group.

The theoretically sound basis would be to have one plan for the entire company. However, this is usually blocked by lack of employee or union acceptance. Unions often block this plan when there are multiple

bargaining units. Employees object when they fail to see the complete picture. They fail to accept the fact that there will be job factors applicable to some groups and not to others; some employees will get a zero evaluation on some factors, while other employees will get a zero on other factors. Zero evaluations trouble these people. To them a zero evaluation for a factor is a psychological insult; they reject the whole general philosophy of such an evaluation program. Nor do they agree with giving some definite point-value to a factor which is not present in a job. Such a procedure appears silly to them; hence, again, they develop non-acceptance of the whole general philosophy of the evaluation program.

Until the people involved can be educated to broaden their thinking, convenience dictates separate plans for broad groups of jobs — such as factory or hourly-rate jobs, and office or salary-rated positions.

Starting with this differentiation, the extremes of jobs that are to come under the plan should be listed, with several intermediate jobs scattered in between. This listing will aid in selecting common factors in the job requirements of all the types of work to be covered.

Such factors may include: (1) education, (2) experience, (3) judgment, (4) physical effort, (5) mental effort, (6) responsibility for equipment, (7) responsibility for material and/or product, (8) responsibility for the safety of others, (9) working conditions — surroundings, (10) working conditions — hazards, (11) initiative, (12) dependability, (13) responsibility for monetary decisions and handling, and (14) analytical ability. This list is not all-inclusive.

If the factor comparison system is to be used, then after each of the factors has been clearly and adequately described, the process of evaluation, previously outlined, is ready to begin.

Determining Degrees and Points

The point system, however, requires a further step. After the various factors have been described, the number of degrees and the points assigned each degree must be determined and fully identified.

As to the number of degrees assigned to any one factor, there is no set rule. The scope of jobs will assist in determining the number of degrees. If the jobs to be evaluated cover a large range, from unskilled to, and including, highly skilled types of work, the number of degrees will be large. Usually it is not possible to identify clearly more than seven or eight degrees of a factor. Listing a greater number of degrees results in serious overlap between successive degrees. On the other hand, the use of too few degrees does not permit the factor to differentiate one job from another. This is explained in the subsequent section on checking the

plan on page 36. In determining how many and which degrees should be used, extreme care has to be exercised. The whole process is largely a matter of judgment, but it can be guided by the checking procedure outlined.

In assigning points to each degree and degrees to each factor, there are certain basic considerations. Either all factors can be considered of equal importance, or some factors can be regarded as more important than others. Also, the successive degrees of any one factor may be considered to be of a constant rate of change or a varying rate of change. As yet, no definite rules exist that can be applied in making a decision in either one of these cases. Job evaluation plans that make use of points have been devised by first judging what the point relationships should be, and then trying out the plan to see whether it works without disturbing too many of the prevailing conditions or relationships of relative base money rates for various jobs. However, as is brought out in the subsequent section, Checking on Evaluation Program, some guidance can be gained in this judgment.

Usually the importance of one factor in relation to another can be judged on the basis of the type of work to be done, along with the requirements of the specific job. For example, in an industry where the experience requirement is low, one would find some such scale as this:

- | | |
|-------------------------------|-------------------|
| 1. Skill factors | 15% of importance |
| 2. Effort factors | 25% of importance |
| 3. Responsibility factors | 25% of importance |
| 4. Working conditions factors | 35% of importance |

whereas in a precision tool industry the scale might be:

- | | |
|-------------------------------|-------------------|
| 1. Skill factors | 50% of importance |
| 2. Effort factors | 10% of importance |
| 3. Responsibility factors | 30% of importance |
| 4. Working conditions factors | 10% of importance |

The magnitude of the points used is a matter of choice. The main thing to avoid is the use of fractional parts of a point or of such a small number that the relative totals are not easy to distinguish. This caution is particularly important when the number of total points for one job differs only slightly from that of another, and the jobs fall in different labor grades. The psychological effect is disturbing, since it is hard to justify such fine measurements in a system based to a considerable extent on subjective judgment. For examples of weighting effect see Charts IV, V, VI, and VII.

Either an arithmetic or a geometric scale may be adopted for use

throughout the plan. As stated, in an arithmetic scale the amount of change is of equal magnitude from one degree to the next for a factor; in a geometric scale the amount becomes increasingly greater from one degree to the next for the factor. Thus far, sufficient study has not been made to determine just which scale is the most satisfactory. Present indications are that best results would require an arithmetic scale for some factors, but a geometric scale for others. Furthermore, there is an inverse relationship between the scale used and the ultimate shape of the wage curve; for example, an arithmetic scale of points gives a curved wage trend, and a geometric scale of points gives a straight wage trend. This is explained further in the section on Wage Curve on page 30.

Job Description

The job evaluation program is no stronger than the weakest of its parts—including job description. In fact, job description is the core of many job evaluation programs. Through the securing of data for the job description, the greatest number of people are reached. This enables them to feel that they have a part in the acceptance of the ultimate resulting labor grades and corresponding money rates.

Yet, in many cases the complete failure of the whole program can be traced to poor job description. Hence it is vital to know what a good job description is and how to make one.

If satisfactory results are to be achieved, the job description must convey to the evaluators a clear, accurate, and complete picture of the job requirements. Some suggest that economic worth of jobs should be included in the job description. As yet, a clear method of presenting this is not available.

Before starting to collect the data about the jobs, other possible uses of the material could well be considered. The data might be applied in such areas as training, employment, placement of the physically handicapped, and safety. When this is kept in mind the data are collected more economically; moreover the psychological effect of conducting just one survey rather than many surveys is good.

The actual data-gathering procedures will vary. A method used in a certain situation will not work in another situation. But ultimately the specific worker and/or his representative, and the supervisors, should be permitted to pass judgment upon the final draft of any description that concerns them.

The problem is to strike a balance between not enough and too much information in the description. There is no sure way of knowing when this balance has been achieved. Some believe that approval by the supervisor and the worker and/or his union representative suffices. This is not

FIGURE IV JOB RATING STANDARD

Blanko Corporation
Anytown, U.S.A.

Code No. X 100
Total Points 281

Job Title Grinder - Rough (Castings)
Department 49 - Grinding Section Foundry

Job Description	<p>Grinds gates, fins, burrs, roughness, etc., from a wide variety of castings such as small blanks attachments to large commercial castings using stand grinder. Checks castings to determine size and type of grinding wheel to use, to perform specified operation according to previous instructions and with proper wheel, first sounding for cracks, places safety washer correctly, and tightens retaining nut. Dresses wheel when necessary with a star wheel dresser to obtain proper wheel surface, and adjusts rest to proper height and distance from wheel to accommodate size of work, or compensate for wheel wear.</p> <p>Shovels castings into pan at machine and manually holds casting between rest and wheel manipulating part in most efficient manner to remove excessive metal. Places ground castings in barrel, and when completed separates grinder's and packer's tickets, places packer's ticket on barrel and rolls barrel out to be trucked to next operation. Occasionally uses hand air grinder for setting types of grinding and burring such as large flat hard iron plates, and inside of scoops and other castings that can not be reached by conventional stand grinder.</p>	
Factor	Rating	Basis of Rating

so. Such clearance, through signatures affixed to the description, can be no better than a guide. Others place fine print at the bottom of the page to the effect:

The above statement reflects the general details considered necessary to describe the principal functions of the job, and shall not be construed as a detailed description of all the work requirements that may be inherent in the job. This fine print does not settle the problem, but evades it. A further guide is the difficulty the evaluators have with the job description. The more

the evaluators of any job differ in their evaluations of job factors, the greater the likelihood that the job description is not clear, accurate, and complete.

It is advisable not to use such all-inclusive words as "operates," "handles," "assists," and "may perform" except when the descriptions go on to define and explain such terms.

The final job description may be in sentence-and-paragraph form or it may be a check list. An example of the former is given in Figure IV.

Two further basic recommendations: (1) The jobs should be reasonably standardized before descriptions are attempted, and (2) descriptions should be reviewed periodically to keep them up to date.

The Actual Job-Evaluation Process

One of the prime reasons for a Job Evaluation Program is the determining as impartially as possible the relative status of each job in respect to all the others. In this step the actual process of making such a determination is set down. Detail is included to the extent that the particular system of job evaluation directs. As previously pointed out, though some systems of job evaluation are more detailed and refined than others, detail alone does not insure a better evaluation job — certain sorts of detail may actually detract from the accuracy of the results. See the section on Cross-checking the Evaluation Program on page 36.

The evaluation may be done by one person or by a partly rotating committee. Committees may be composed of management alone or of management and labor. At least some members of any such committee should be permanent, with one person in charge throughout all the evaluations. Rotating members attend meetings at which jobs in their work area are being evaluated and may also attend meetings that deal with other jobs in which they are interested.

It is best for each person to do his assigned evaluations independent of the others and then to compare the results. Any differences are to be discussed and reconciled. There are two possible methods: (1) Evaluating all jobs on one factor before proceeding to the next factor or (2) evaluating a job on all factors before proceeding to the next job. The first method is preferred, to avoid the unduly frequent change of pace and thought required in the second method.

Delay in reconciling differences of opinion about the rating of a job may be due to lack of clarity in the job description — or to plain stubbornness. If the former, a new job description may be called for. These non-reconciled evaluations are the main check on the adequacy of the job description. It is, in fact, about the only sound check available.

In those cases in which stubbornness prevents reconciling differences

in evaluations, the task may be set aside until all other jobs have been evaluated. Then, the differences can usually be eliminated. It is undesirable to engage in "horse-trading" on the evaluations for these jobs.

A final form for a job evaluation can be made part of the job description form, or it can be on a separate sheet accompanying that form. See Figure IV for job description. Figure V suggests the type of rating and basis of rating which may be used.

At this point, the jobs should be arranged in the order of their relative worth. However, it may be found that some evaluations do not reflect the intentions of the job evaluation plan. Furthermore, the additive results of each factor evaluation may not give the value of importance which people may attach to certain jobs. This means that considerable cross-checking should be done, by methods set forth in a subsequent section on page 36.

Wage Survey

The purpose of the wage survey is to collect comparable wage data that will enable the particular plant to determine on what wage levels it wants to operate or has to operate and assist in reducing, if not eliminating, inequities which are in existence. Any plant is confronted with inequity problems due to:

- (1) Inequities within its own plant.
- (2) Inequities within its industry.
- (3) Inequities within its labor market area.
- (4) Gross inequities between industrial types within the labor market area.
- (5) Some combination of two or more of the above classifications.

Just what the particular plant or company may do depends upon what it wishes to achieve in the product-competition field and/or in the labor market.

The first step in the wage survey is the selection of those jobs to be covered by the evaluation program. The process should: (1) Give a rather complete coverage over the range of jobs evaluated; and (2) list jobs which are fairly standard in job content in the area to be surveyed.

The second step is to draw up a list of organizations from which to secure data.

Then, with a list of wage rate classifications (i.e., average hourly earnings, base rate, occupational rate, etc.) it is best to make personal calls to each company. In these calls a comparison of jobs can be made by job content only. The wage data should be carefully gone over to be

FIGURE V

JOB RATING STANDARD

Blanko Corporation
Anytown, U.S.A.

Code No. X 100
Total Points 281

Job Title Grinder - Rough (Castings)

Department 49 - Grinding Section Foundry

(See Figure IV for Job Description)		
Factor	Rating	Basis of Rating
<u>1</u> General Knowledge	<u>1</u> (5)	Requires the ability to understand English, understand and carry out specific oral instructions and recognize signs.
<u>2</u> Experience	<u>4</u> (48)	Requires 6 to 9 months experience to perform routine semi-skilled work of grinding fins, burrs, gates, etc., from a wide variety of Blanko attachments and castings using various sizes and types of grinding wheels on stand grinder and hand air grinder.
<u>3</u> Judgement	<u>3</u> (21)	Some judgement required on standardized rough grinding operations where variations in location of burrs, fins, gates, etc., on a wide variety of Blanko attachments and castings. Involves making decisions such as correct grinding wheel to use, distance between wheel and rest and type of rest best suited for job and maximum production.

4	Initiative & Ingenuity	2 (14)	Performs work of grinding gates, fins, burrs, etc., off castings, according to limited detailed instructions in following standard grinding methods but makes occasional changes in grinding rests and set-ups to grind castings in more efficient manner.
5	Manual Dexterity	4 (24)	Considerable manual skill and speed in the use of fingers, hands, and arms on repetitive operations of holding castings between rest and grinding wheel and manipulating part in most efficient manner and against wheel without use of grinding rest and burring of Blanko attachment where burrs are ground off by rapid touching of head and open end on side of wheel.
6	Accuracy	2 (16)	Moderate accuracy required in performance of rough grinding duties involving removal of fins, burrs, gates, etc., from a wide variety of castings where care must be taken to insure removal of the proper amount of metal.
7	Physical Activity	4 (28)	Sustained repetitive physical activity in manipulating Blanko attachments and castings between rest and wheel and burring of Blanko attachments and castings on wheel when rest is not used. Requires manual pressure for all types of grinding.
8	Strength	5 (25)	Requires the strength and physical activity to constantly handle castings weighing up to 5 lb and lift 30 to 50 lb.
Total Points			281
Date			1/2/50

sure that comparable data are being received. For example, wage rates can be influenced by:

- (1) Average hourly earnings.
- (2) Incentive bonuses or premiums.
- (3) Nominal operating hours.
- (4) Inclusion of overtime pay.
- (5) Relationship of guaranteed day-work rate and incentive plan used.
- (6) Number of persons in each job in each plant surveyed.
- (7) Special benefits and privileges.

The above list, though not all-inclusive, does suggest the various differences that should be looked for.

All data should then be compiled and any data not comparable should be eliminated from further use. Copies should then be supplied to plants cooperating in the wage survey.

Wage Curve

Even after eliminating irregular wage data collected during the wage survey, one will soon discover that plotting the wage curve presents some problems.

The ultimate purpose of the wage curve is to arrive at the relative money rates which are to be paid for all the jobs which have been evaluated. These rates should reflect, in general, the relative status of the jobs evaluated.

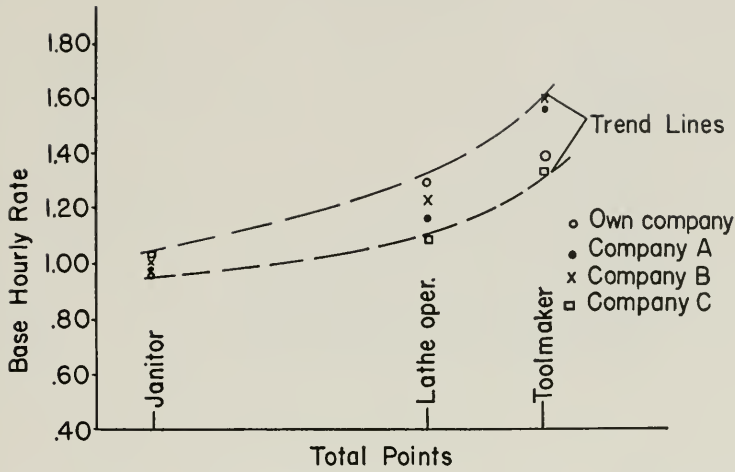
The first step is to plot, on graph paper of convenient size, the relative evaluations of the jobs along one ordinate, and the money rates along another ordinate. See Figure VI. All usable wage data from the wage survey, and rates within the plant, should be shown. (It is desirable to key the data so that the sources of information from any particular plant can be readily identified.) The resulting plot will show that no trend line will be possible which will include all the points plotted. Rather, there will be range trends, as shown by the dotted lines in Figure VI.

There are two ways in which trend lines can be established: mathematically, by what is known as the least-squares method, or by estimating.

The method of least squares is defined and described in any text on statistics. This method is sound mathematically. But it is not practical here because the original data are based on judgment and not on absolute facts. It is foolish to apply a detailed mathematical procedure to data which are not absolute in the engineering sense.

A second reason why this method is undesirable is that the trend line

FIGURE VI



Note: Data from Chart I. Illustrative only.

is not necessarily straight, and since the method of applying the least squares is easiest for a straight line, people tend to force a straight line on data which should yield a curved line. Then, to establish labor grades, the straight line is broken up — “roughed up” — into steps. What these objections all add up to is that the method of least squares gives a false sense of exactness. It looks scientific, but isn’t.

Another matter to settle is the general shape of the trend lines. Should they be straight lines or curved lines? There is no answer to this question except as indicated by the data. It is reasonable to assume that if a wide range of skills is being covered by the one evaluation program and if the original measuring scales are arithmetic scales (for example, 5, 10, 15, etc.), the trend lines will be curved, concave upward, when the data are plotted on ordinary arithmetic graph paper. If, however, the original measuring scales used in the evaluation are geometric (for example, 10, 20, 40, 80, etc.) the trend line will be a straight line. The narrower the range of skills to be covered by the evaluation program, the more nearly straight the trend lines.

Once the trend lines indicate the range of rates which prevail for the various jobs, the next consideration is to settle where within the range the particular plant can operate. There are two extremes: (1) at the bottom of the range throughout, and (2) at the top of the range throughout. Other alternatives are any number of places between the range lines. Each company must set its own policy in this regard, on the

basis of the product and labor competitive markets and with due regard to collective bargaining obligations if such exist.

If a single rate structure is the final aim for each labor grade, the establishment of the average trend line will permit going directly to establishing labor grades. However, if rate ranges are to be used for each labor grade the trend lines will show one of the following tendencies of the range between the lines: constant money range, constant percentage range, or variable money and percentage range. Here, again, a policy needs to be determined. Usually, the wider the range of skills covered by any one job evaluation program, the more the trend will be toward a variable percentage range. This is necessary to permit more variability in rates for higher-skilled jobs. Furthermore, the use of rate ranges for each job requires a policy on how the progression is to be made from the lowest to the top rate for the job. Is this progression to be according to seniority, merit, or a combination of seniority and merit?

Labor Grades

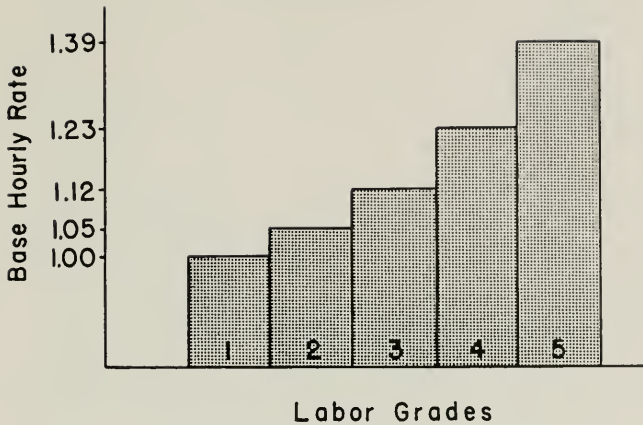
In the previous section, Wage Curve, a trend line was determined, which relates the relative evaluation of the jobs with a money rate to be paid. However, one will quickly discover that a great number of wage rates will be present if the study stops with the wage trend line. Furthermore, since the whole system up to this point is based on judgment, even though it is perhaps sound, many money rates will be a fraction of a cent different for very similar jobs. Such a fractional cent variance is nearly impossible to explain and justify to those expected to accept and work with the results of a job evaluation system. Also, to keep a record of so many different rates becomes an increasingly difficult accounting problem for management as well as a union.

To overcome the psychological aspect of small fractional cent variance for similar jobs, jobs are grouped into what is known as labor grades. This grouping of jobs into labor grades reduces the friction which would result with small fractional cent variances because all jobs in any one group, or grade, will carry the same rate or rate range.

It is desirable that a few basic rules be observed in establishing labor grades. They are: (1) the number of grades should be established to provide sufficient incentive for movement from grade to grade; (2) the overlap between labor grades, if rate ranges are used, should not be excessive; and (3) a rational pattern of differentials should exist throughout the labor grades.

Considering the first basic thought, the number of labor grades established, one finds that there is a workable minimum as well as a maximum established through practice. The minimum condition is to have labor

FIGURE VII



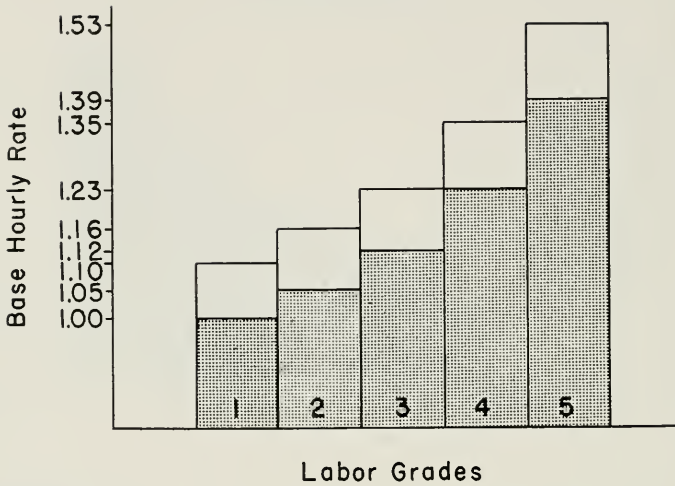
grades with at least five or six percent of the base rate differentials between successive grades. Values less than that will lead back to the problem of fractional values, and it will be nearly impossible to secure acceptance, as previously stated. The maximum limit of differentials between successive labor grades will depend upon the range of skill classifications to be covered by the job evaluation plan (i.e., unskilled through semi-skilled to and including high-skilled jobs is the top consideration). For the ordinary jobs usually found, and included in the job evaluation plan, in a mass production industry the differential amounts to about ten to fifteen percent of the specific base rate. Higher differentials make the jump from labor grade to labor grade too abrupt and create distrust.

This whole situation can be illustrated graphically as shown in Figure VII. In this case the differential between labor grade one and two is five percent; between grades two and three, about seven percent; about nine percent between labor grades three and four; and around eleven percent between the fourth and fifth labor grades.

In the case of the overlaps between labor grades one should consider the psychological impact of the status of workers in various grades. Whether it is justified or not, each worker builds up a feeling of status based somewhat on his particular labor grade assignment and the corresponding money which is attached to the labor grade. It is this status, as well as the yet unsolved problems of impartial and inadequate systems of merit rating, which has caused many plans to resort to a single rate for each labor grade. This is to avoid the problem that arises as the result of both overlap and merit rating.

When labor grades overlap there is a possibility of a person in one

FIGURE VIII

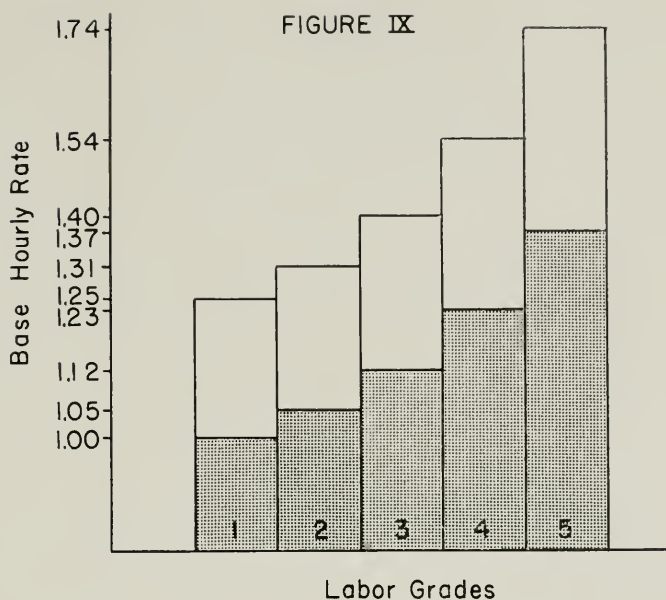


labor grade receiving the same hourly rate as a person in the next or subsequent labor grade. Usually this overlap is spoken of in terms of money. An illustration of no overlap is shown in Figure VII. Here each successive labor grade—a single wage structure—pays a distinctly different rate. There can be no case of people assigned to different labor grades receiving the same amount of money per hour, or what ever other pay basis is used.

Should rate ranges be used in Figure VII one may get a picture as shown in Figure VIII.

In Figure VIII an arbitrary rate of ten percent of the starting rate was used in each case. But, note that between labor grades one and two there is an overlap of five cents; between labor grades two and three, a four cent overlap; and no overlap between grades three and four and even a gap of four cents between grades four and five.

For example, if an arbitrary rate of twenty-five percent of the starting rate is used for the rate range in each grade, Figure IX results. In this case there is an overlap between each two successive labor grades. However, there is a serious overlap picture developing. Considering grades one and four, there is an overlap of three cents. The type of work—even the minimum work—which will be found in grade four should be far superior in requirements to that in grade one; yet someone in grade one could receive equal to or better than a person in grade four. Such a situation hits strongly at the psychological status of the worker in grade four. This successive overlap should be avoided. This is even more serious



if a job in labor grade one is on incentive and a job in labor grade four is on day work.

A certain amount of overlap is essential for management to provide flexibility of transfer and upgrading with no additional expense during the employee trial period on the new job.

A third thought on establishing labor grades is to have a rational pattern of differentials throughout the labor grades. In Figure VII this pattern is 5 (difference between \$1.05, grade two, and \$1.00, grade one, etc.), 7, 11, 16. Another pattern could be 5, 5, 5, 5; or 5, 6, 7, 8. But a pattern of 5, 7, 8, 12 is hard to justify because a suppression is shown in the middle, as contrasted with the implication of increasing importance of successively higher labor grades.

There are many other important considerations in establishing labor grades. It must be kept in mind that:

- (1) Tradition is hard to overcome; so grouping of jobs into labor grades may have to be a little different than strict evaluations order.
- (2) Occupational grouping of jobs should be considered.
- (3) General union feeling and prevailing practice in the area on the number of labor grades should not be ignored.
- (4) The greater the difference of the rate for the lowest paid job and that for the highest paid job, the more labor grades one will have.

CROSS-CHECKING THE EVALUATION PROGRAM

The foregoing sections have outlined the general and procedural aspects of job or position evaluation. As is evident, much of the mechanics is based on judgment. But, there is need for better guidance in the judgment process than has been evident in practice to date. In this section some procedures are given to assist in this judgment process. Under no conditions are these procedures the absolute measure and neither are they to be used as the sole criterion. There are too many problems within the company and too many problems arising from forces outside the company — problems and forces that cannot as yet be fully evaluated — to allow a dogmatic solution.

Factors to be considered in cross-checking the evaluation program include:

- (1) The effectiveness of each factor.
- (2) The validity of each factor.
- (3) The validity of factors in respect to each other.
- (4) The continuance of validity of the plan.

Effectiveness of Each Factor

This means: is the factor necessary and is it fully used? In many cases a factor (see Charts IV, V, VI, and VII) is listed with several possible degrees of its use. Such listing assumes that the factor is necessary and that it is to be fully used. The latter is important when considering item

CHART VIII

FACTOR: Experience	
Degrees	Jobs assigned
1	1
2	6
3	3
4	8
5	11
6	2
7	3
8	1

CHART IX

FACTOR: Work Hazards	
Degrees	Jobs assigned
1	—
2	5
3	5
4	21
5	4
6	—

three, the validity of factors in respect to each other. To check the first point, one should tabulate the degrees for the factors and the corresponding number of jobs assigned to each degree. Such a tabulation could be as shown in Chart VIII. This shows that the factor is at least used throughout its range. Whether it contributes to the plan properly will be shown subsequently. In the following illustration, Chart IX, some question is to be raised regarding the effectiveness of the factor, especially since the trend is to simplify jobs in industry, rather than to make them more complex. Therefore, if the higher degrees, especially those of a factor, are not used at the time of installation of the job evaluation program, it is even more likely that they will not be used in the future. This has a special impact on the validity of factors in respect to each other.

Validity of Each Factor

The second consideration, the validity of the factor, is a measure of how distinctly the factor is separated from other factors in the plan. The first step is to tabulate the jobs and to set opposite each job the rating for the factors to be checked against each other. A suggested tabulation is shown in Chart X. The same data then can be plotted on a graph as in Figure X.

If the trend line can be established as shown, if the points cluster close to the trend line, and if the slope is at about 45 degrees, rising or falling (assuming uniform scales on the graph), then there is a high correlation between the two factors. In such a case, one factor or the other is sufficient in the plan; if both are used, usually they are measuring the

CHART X

Job	Factor One Rating in degrees	Factor Two Rating in degrees		Job	Factor One Rating in degrees	Factor Two Rating in degrees
1	2	1		19	3	3
2	1	1		20	3	3
3	1	2		21	2	3
4	2	1		22	2	3
5	1	1		23	3	3
6	1	1		24	3	3
7	2	2		25	3	4
8	2	2		26	3	2
9	1	1		27	3	2
10	2	2		28	3	2
11	2	2		29	3	2
12	2	2		30	3	2
13	3	4		31	5	4
14	5	5		32	5	4
15	2	2		33	3	2
16	2	2		34	3	2
17	1	3		35	3	2
18	2	3				

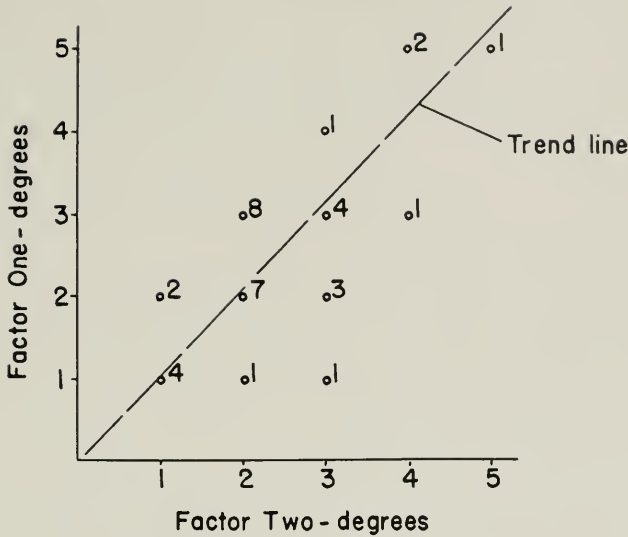
same thing. If no trend line can be quickly seen, or if a trend line running nearly horizontal results, each factor is measuring a relatively different feature of the job.

Validity of Factors in Respect to Each Other

The third item, the validity of factors in respect to each other, considers the importance attached to the individual factors. In Charts IV and VI each factor is considered to be of equal importance and each factor has the same number of points assigned to it as do each of the remaining factors. In Chart V, however, some factors are considered more important than other factors. This is shown by a different number of degrees, so that even though all factors start out with the same number of points, some factors can have a higher average rating than others. Chart VII definitely shows the variable importance attached to respective factors.

There is nothing wrong with the importance attached to each factor

FIGURE X



except that the entire weighting is based on judgment. Furthermore, the plan is explained as such to those who will operate under it. The purpose of this check is to make sure that: (1) the judgment of factor importance is correct, and then that (2) the average collective results of the job evaluations are the same as the plan shows. For example, is it a correct judgment of the factor "experience" to make it twice as important as the factor "working conditions"? Do the average collective results of the evaluations of all the jobs show this to be so?

To make this check on the relative importance of factors, consider the following example. From Chart X the average rating for Factor One is 2.48; and for Factor Two, 2.37. (Secured by adding all the degree ratings for Factor One and dividing by the number of jobs considered. Likewise, for Factor Two.) Then add the difference, regardless of sign, between 2.48 and each job rating for the factor. For Job One, for example, the difference is 0.48. Divide this total by the number of jobs considered. For Factor One this arithmetic deviation is 0.84; and for Factor Two, 0.81. In terms of points, Factor One is 4.20 (secured by multiplying 0.84 by the 5-point intervals between degrees) and Factor Two is 8.10.

The specific plan from which the data were taken is shown in Chart XI. This shows that Factor Two is considered to be double the importance of Factor One. If this is the case, the arithmetic deviations for these factors should have the same or nearly the same relationship. The actual figures in this case show that the ratio is nearly two (8.10 divided by

CHART XI

FACTOR	Degrees				
	1	2	3	4	5
One	5	10	15	20	25
Two	10	20	30	40	50
Three					

4.20). So the two factors in use are contributing, on the average, to the results in accordance with the plan as designed. This is a reasonably close approximation method to use to guide judgment.

Continued Validity of the Plan

A fourth point to check is the continuance of the validity of the plan. It is important to recognize that from time to time new jobs will be evaluated, and changed jobs will be re-evaluated. The main question that arises is: How do these new evaluations change the actual collective results from what they were at the time of installing the plan? The method used to answer this question is equivalent to setting up a quality control chart of much the same sort as that used by production departments.

The procedure will be to determine the average rating for each factor at the time of installing the plan. Then periodically—every six months or a year—the average factor ratings should be determined for all evaluations which have been made within the six months or year period. These average ratings are then compared with those at time of installation. Differences will indicate whether or not the new evaluations are more lenient or more severe than those that were adapted at the time of installing the plan. This sort of check helps keep inequities from developing.

INSTALLATION AND MAINTENANCE OF PLAN

Before a job evaluation plan is actually installed a considerable amount of explanation and selling has to be done to those who have to operate with it. This selling is a continuous process. It must go on throughout the period of establishing the plan and ever afterwards.

Above all, remember a job evaluation plan is used in a dynamic situation, and it needs continual guidance by someone who has been assigned

this responsibility and who makes this responsibility an important part of his work.

A procedure must be set up which, among other things, will:

- (1) Handle all grievances on present evaluations or re-evaluations.
- (2) Periodically review the jobs to ascertain whether or not the jobs are the same as originally described.
- (3) Periodically conduct sound wage surveys.
- (4) Continue to receive support from all those closest to the jobs — as by calling attention to job content change.
- (5) Provide close check upon adherence to job description in work assignments — except in emergencies.
- (6) Provide a constant source of assistance to show and solve impacts of the job evaluation plans on other personnel policies and labor contract provisions.

CONCLUSION

This *Bulletin* is intended mainly to present the techniques of job evaluation (or position evaluation) and to indicate many “fringe” aspects which must be considered. It does not attempt to discuss when and by whom job evaluation should be adopted. That is a decision to be made by management and labor representatives in each situation. As is evident, judgment forms an important part of any job evaluation. And, since judgment is not positive in measurement, psychological and sociological aspects take on added meaning in any evaluation. No attempt has been made here to weigh the pro and con of any of the human relationships. Instead, the reader is encouraged to investigate other current publications on the subject, some of which are listed in the following bibliography.

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